

From Arboretums to Your Garden

For almost 75 years, the U.S. National Arboretum's Floral and Nursery Plants Research Unit (FNPRU) has been a leader in the development of new and improved floral and nursery products. The 446-acre arboretum's advances in genetic improvement and disease control of landscape plants and major cut flowers have, in no small part, contributed to the rapid growth of the floriculture crop sector of American agriculture—which had a \$3.5 billion wholesale value in 1998. (See “Floral Gems,” *Agricultural Research*, September 1997, pp. 8–13.)

FNPRU's research activities have helped spur the burgeoning floral and nursery crops industries in myriad ways. From their germplasm improvement, taxonomy studies, and development of virus- or pest-resistant plants to the creation of plant pathogen detection methods and genetic transformation technologies, the research unit's scientists continue to engage some of the horticulture industry's most enduring challenges.

“A 1996 horticulture research initiative spearheaded by ARS Administrator Floyd P. Horn has been tremendously beneficial to the industry,” says Mary Ashby Pamplin. She previously directed horticultural research for the American Nursery and Landscape Association.

“Through labs like the FNPRU, ARS does something that we as an industry cannot; that is, conduct the long-term, high-risk, and costly basic research that forms the building blocks for the industry's own research programs,” Pamplin says. “ARS is in a perfect position to coordinate research across disciplines at a very high level and to effectively communicate its findings.”

This cooperation with industry informs much of what ARS scientists accomplish at FNPRU and at the more than 100 ARS laboratories across the country and abroad and provides researchers with an incentive to find solutions to difficult challenges.

Over the last 10 years, the FNPRU has been engaged in detecting, identifying, and characterizing several viruses affecting ornamental crops. Among the tools scientists use are

antibodies, electron microscopy, and nucleic acid hybridization. These approaches include developing control procedures to prevent or minimize virus transmission, finding reagents to quickly detect and screen viruses, and quarantine interception and epidemiology.

Following are some research programs that highlight the depth and breadth of FNPRU's activities.

Using Genetics To Plum the Depths of Plant Diseases

The plum pox virus (PPV) research program, led by plant pathologist John Hammond, has yielded sensitive detection techniques that not only confirm the presence of PPV—a disease that affects stone fruits like plums, peaches, and their ornamental relatives—but also distinguish between severe and less virulent strains of the disease and help determine their origins and modes of transmission. (See related story on p. 9.) To the \$1.3 billion annual U.S. stone fruit industry, this kind of research is critical.

Hammond uses a technique called the polymerase chain reaction (PCR), which multiplies the number of target molecules in a sample's nucleic acid. Having enough copies helps researchers detect any particular strain of PPV. “We've been able to develop PCR primers that initiate this process,” says Hammond. “The process allows us to more readily detect all PPV strains.” If scientists can detect different strains, it may help them find a correlation between a particular strain and its ability to infect a specific type of host plant.

SCOTT BAUER (K9608-1)



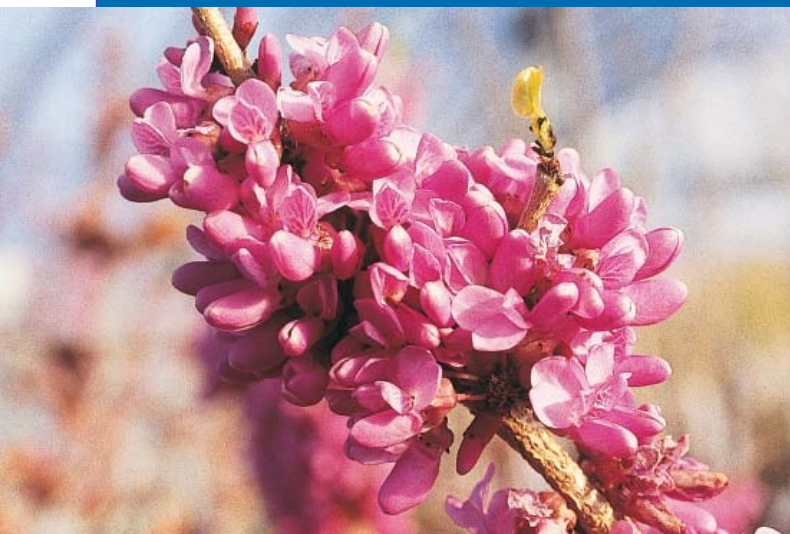
Technician Brandy Jones examines a rose plant that began as cells grown in a tissue culture.

New Redbuds and Lilacs Grace America's Gardens

FNPRU's Margaret R. Pooler has released a new Chinese redbud cultivar named Don Egolf, a variety of *Cercis chinensis* whose profusion of rosy-purple flowers, compact structure, ease of propagation, seedlessness, and apparent high tolerance to *Botryosphaeria dothidia* canker have made it a welcome newcomer to nurseries across the country. Since 1994, cooperating nurseries throughout the eastern, southern, and

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MARGARET POOLER (K9608-20)



New Chinese redbud cultivar named Don Egolf, released by Margaret Pooler of the U.S. National Arboretum.

midwestern United States have evaluated Don Egolf with high acclaim. Its ease of propagation by rooted cuttings is an especially valuable trait, because redbud cultivars are notoriously difficult to propagate. Because the cultivar is seed-sterile, it produces no fruit—enhancing the shrub’s winter appearance.

In addition, Pooler’s release of a new *Syringa* cultivar named Betsy Ross has provided the industry with a new lilac acclaimed for its fragrant white flowers, lush green foliage, compact

PEGGY GREB (K9615-3)



Roses at the Secrest Arboretum in Wooster, Ohio.

growth habit, disease tolerance, and adaptation to warmer climates. One significant advance has been the new lilac’s tolerance to powdery mildew—the biggest disease problem for lilacs in the Washington, D.C., area. The new shrub thrives under full sun and can be used as a background planting in a shrub border or as a specimen plant or hedge. It can be planted throughout USDA hardiness zones 5 to 7.

A Rose Is a Rose Is a Rose

Researchers at FNPRU have also developed a new technique to enable transformation of genetically diverse varieties of roses—the number-one cut flower in the United States. One of the principal obstacles to the genetic engineering of roses has been an inability to develop a whole plant from genetically engineered cells. “This technique has already been applied to three rose varieties with great success,” says Kathryn K. Kamo, a plant physiologist. The new method can potentially be used to genetically introduce traits such as resistance to black spot, along with quality traits, like scent, color, and heat tolerance.

Nightmare on Elm Street Is Over

The tree-breeding program at FNPRU has successfully bred red maples with both good fall color and leafhopper resistance; elms with tolerance to Dutch elm disease and elm yellows;

superior alder and hackberry; and hemlock with wooly adelgid resistance. New hemlock hybrids are being verified with the use of molecular markers.

Over the past 20 years, plant geneticist Denny Townsend has worked to develop the first commercially available elm varieties that are tolerant to Dutch elm disease. After their long-awaited arrival in wholesale nurseries in 1997 and retail nurseries in 1999, the American elm is well on its way to gracing our boulevards and backyards once again.

Novel Approaches to Plant Breeding

Plant geneticist Robert J. Griesbach, with FNPRU, has been developing five new *Ornithogalum* hybrids. The best-known species of this bulbous plant is the Star-of-Bethlehem. These new hybrids—for which patent applications have been filed—introduce new colors and growth habits through interspecific

Technicians Brandy Jones (left) and Siobhan O'Connor examine rose cultivars regenerated from somatic embryos in tissue culture. This technique will be used to genetically engineer roses for disease resistance.

SCOTT BAUER (K9609-1)



breeding and embryo rescue techniques. The introduction of disease resistance is projected in the future through genetic engineering. According to Griesbach, he and colleagues have been able to develop whole plants from rescued embryos that have been germinated from immature seeds. “Under normal circumstances these embryos would die,” he says. “The resulting plants have larger, fuller flowers and stronger, longer stems.”

Minor Crops Make Major Impact With IR-4

Recognizing the economic importance of the \$32-billion-a-year U.S. “minor” crop industry, the FNPRU is a major participant in an ornamental minor-use pesticide (IR-4) program. The IR-4 program’s role is to conduct the research necessary to receive Environmental Protection Agency (EPA) approval of pesticides for use on minor crops—those grown on 300,000 or fewer acres in the United States. Large agricultural chemical producers normally play this role for products geared to large-scale crops, like corn and wheat, that will allow them to recoup their investment in research and testing. Minor crops do not provide such an incentive. That’s where the IR-4 program comes in.

FNPRU plant pathologist James C. Locke conducts pathology and entomology studies in support of the IR-4 program. “Another of our projects involves development of nonpesticidal approaches to control soilborne and foliar fungal pathogens using biological control agents and natural plant products,” says Locke. He plans to further develop one such product—a clove oil formulation—with the help of industry cooperators.

Midwest Testing

The ornamental minor-use pesticide program relies on another arboretum—the Ohio State University’s (OSU) 85-acre Sequest Arboretum, in Wooster, Ohio. ARS pesticide-application scientists there have a decided advantage, with their laboratory and offices on OSU’s 2,400-acre Ohio Agricultural Research and Development Center, which also has nurseries, greenhouses, and adjoining research farms.

“When we want to do field tests for IR-4, we have the arboretum available as well as the nurseries and greenhouses,” says

MARGARET POOLER (K9608-19)





A picturesque scene at the Secrest Arboretum.



The new lilac cultivar named Betsy Ross, released by Margaret Pooler of the U.S. National Arboretum, has fragrant white flowers and tolerates powdery mildew.

Charles R. Krause, who heads the ARS Application Technology Research Unit. This unit conducts basic research to reduce pesticide use while improving disease and pest control and enhancing profitability for growers. Several other ARS units as well as OSU and other land grant universities nationwide participate in the IR-4 program.

The Wooster arboretum has one of the oldest and best collections of Japanese yew trees in the world and one of the largest collections of crabapple trees in the country. Its landscape is beautiful year-round, but puts on its best show for Mother's Day, with numerous red and white and pink azaleas and rhododendrons blooming along with the pink crabapple flowers. It's not hard to see the economic value of all this beauty to customers of commercial nurseries and greenhouses. One acre of the red maples on the arboretum's grounds would bring several thousand dollars in sales to commercial operations.

Tourist season peaks in spring, but locals enjoy the arboretum year-round, taking self-guided tours or walking and jogging the paths.

Krause's unit partially supports the arboretum with equipment and services and in turn uses the arboretum's research facilities for testing new pesticides and the best and safest ways to apply them. For example, the crabapple collection serves the unit well during its current focus on apple scab, a fungus that attacks the trees. Krause or his colleagues can drive less than a mile from their lab to the arboretum, take a crabapple leaf sample suspected to have apple scab fungus, and examine it with one of ARS' new scanning electron microscopes in a matter of minutes.

Using apple scab as a hypothetical example of how IR-4 works, Krause—who has been with the program since the ornamental component was added in 1977—describes the process: "Nursery or greenhouse people go to their county extension agents and tell them that the pesticides they're using are no longer doing the job. They've heard that a newer

fungicide works better, but it's not labeled to control apple scab fungus, so they can't legally use it on crabapple trees. The agent would start a long, careful process in which the IR-4 headquarters at Rutgers University would first contact the registrant—the company that makes the newer fungicide—and ask them if they agree with the request. If they don't, the whole process stops right there." Efficacy, marketing, and patent liability are some reasons why the registrant might reject label expansion.

If, on the other hand, they say yes, then committees of experts at annual workshops study the request to check its feasibility. If the request passes through several layers of approval, the project is assigned to an appropriate lab, such as Krause's, to see how the newer fungicide works on crabapple trees. If everything works out, the company uses the research data to apply for EPA permission to add crabapple trees to the legal uses on the fungicide's label. The fungicide could be a synthetic chemical formulation or it could be a biological control.

If the new label request is for potted plants, Krause would buy about 20 of the plants in pots or containers and test the newer pesticide on them in the arboretum. He would see if the pesticide damaged the appearance of the plant, was effective against the problem pests, and was safe for the environment, wildlife, pets, and people—including people who would live or work near the plants and children who might sample the plants. Also, if the plant were to be widely used inside office buildings, it would be important that the pesticide not have a strong odor.

Krause says he sees IR-4—started to keep pesticides available and safe for food crops—as a model for cooperation among state and federal agencies, private companies, environmentalists, and consumers. The IR-4 program, which stands for Inter-regional Research Program No. 4, was established in the early 1960s and gained momentum after the Federal Insecticide, Fungicide, and Rodenticide Act was amended in 1988.

IR-4 ensures that the United States has the safest food and ornamental plant products in the world because of its system of checks and balances, including regulation by EPA, says Krause. There are many regulations protecting food and ornamental plants, such as the Food Quality Protection Act of

PEGGY GREB (K9612-1)



As part of the IR-4 program to test pesticides for use on minor crops, technician Betsy Anderson sprays a chemical on geranium plants.

1996. He says he is proud to be a pioneer member of the diverse team of researchers who ensure this and is grateful for the great outdoor lab the Secret Arboretum offers.

People increasingly come to greenhouses, garden shops, or nurseries to buy landscape plants for beauty, shade, privacy, wildlife benefits, or noise abatement. Krause and others work to ensure that ornamentals shipped to garden centers across the United States are in beautiful shape and have no levels of pesticides that could harm the elderly or children, and no offensive odors.

The IR-4 work is a good fit with Krause' group, since their basic charge is to find the best and safest ways to apply pesticides to food plants and ornamentals.

"We have to get the pesticide to the target for it to work," Krause says. "It doesn't matter how good the pesticide is if you can't reach the pest with it."

While they are testing a newer pesticide for a broader application

labeling, they will change the labeled application procedures to include safer and more efficient application methods that result from their testing.—By **Jesús García** and **Don Comis**, ARS.

The National Arboretum research is part of Plant, Microbial, and Insect Genetic Resources, Genomics, and Genetic Improvement (#301), Plant Biological and Molecular Processes (#302), and Plant Diseases (#303). The Wooster, Ohio, research is part of Plant Diseases (#303) and Crop Protection and Quarantine (#304). These four ARS National Programs are described on the World Wide Web at <http://www.nps.ars.usda.gov>.

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